

REMARKS

This amendment is responsive to the Office Action of March 23, 2005. Reconsideration and allowance of claims 1-16 and 18-24 are requested.

The Current Status Of The Claims

In the Office Action mailed March 23, 2005:

Claims 1-11 and 19-24 stand rejected under 35 U.S.C. § 102(e) as being anticipated by Zhu et al., (US 6,721,589, hereinafter "Zhu").

Claims 1-24 stand rejected under 35 U.S.C. § 102(e) as being anticipated by Prince et al., (US 6,597,935, hereinafter "Prince").

Applicants Ask For Reconsideration Of The Anticipation Rejections Of

Claim 1 Based On Zhu And Prince

In applying **Zhu** against claim 1, the Office Action states that Zhu discloses cardiac gated imaging triggered by an ECG and employing spatially modulated heart magnetization. Office Action at pp. 2-3. The statement of reasons for rejection describes a conventional SPAMM or CSPAMM type tagged ECG-gated cardiac sequence, such as is also described in relatively substantial detail in the "Background of the Invention" section of the present application, with particular reference to Fig. 1 of the present application which is appropriately labeled "Prior Art".

The Office Action does not claim to have found in Zhu a data acquisition sequence including the first preparation sequence block, first imaging sequence block, second preparation sequence block, and second imaging sequence block occupying an acquisition time interval which is less than a cardiac cycle interval of the heart. Claim 1 calls for this.

Figures 2 and 9 of Zhu each show that the preparatory tagging pulse sequence (202, 2020) are applied once after each R-wave (200). *See also* Zhu col. 4, lines 3-7. Zhu teaches only one preparatory pulse sequence per cardiac cycle interval.

Because Zhu does not disclose, either expressly or inherently, each and every element of claim 1, it follows that Zhu cannot anticipate claim 1.

See MPEP § 2131. Accordingly, Applicants respectfully request that the anticipation rejection of claim 1 based on Zhu be reconsidered and withdrawn.

Similarly, the Office Action states that **Prince** discloses cardiac gated imaging triggered by an ECG and employing SPAMM or CSPAMM. Office Action at p. 3. The statement of reasons for rejection again describes a conventional SPAMM- or CSPAMM-type tagged ECG gated cardiac sequence.

The Office Action does not claim to have found in Prince a data acquisition sequence including the first preparation sequence block, first imaging sequence block, second preparation sequence block, and second imaging sequence block occupying an acquisition time interval which is less than a cardiac cycle interval of the heart. Claim 1 calls for these.

Because Prince does not disclose, either expressly or inherently, each and every element of claim 1, it follows that Prince cannot anticipate claim 1. See MPEP § 2131. Accordingly, Applicants respectfully request that the anticipation rejection of claim 1 based on Prince be reconsidered and withdrawn.

Claims 1-3 And 5-14 Patentably Distinguish Over The Cited References

The use of first and second preparatory sequences occupying an acquisition time interval which is less than a cardiac cycle interval, as called for in claim 1, is both novel and not obvious. As noted in the present application at least at page 15 lines 17-36, using multiple tags within a single cardiac cycle interval raises significant concerns about bleed through overlapping of tags and imaging discontinuities.

However, the inventor has found through experimentation that, when carefully designed, a data acquisition sequence including two or more sets of SPAMM, CSPAMM, or similar preparatory sequences within a single cardiac cycle interval is feasible. (See p. 15 lines 17-36). The inventor has found that including two preparatory sequences in a single cardiac cycle interval is typically optimal. *Id.* In some cases, up to four spatial magnetization tags within a single cardiac cycle interval has been found to be feasible. (See p. 15 lines 18-20).

In existing approaches such as those of Zhu and Prince, the portion of the cardiac cycle interval distal from the tag provides weak tagging (SPAMM) or weak

image contrast (CSPAMM). Fig. 2C (SPAMM) and Fig. 3C (CSPAMM) of the present application, both of which are labeled "Prior Art", aptly illustrate this loss of tagging (SPAMM) or image contrast (CSPAMM) that occurs when using existing tagging techniques.

CSPAMM was developed to overcome the tag blurring encountered in SPAMM. *See* present application p. 4 lines 15-36. However, CSPAMM trades loss of image contrast for improved tag persistence. *See* present application p. 4, line 37-p. 5, line 12. The approach of the present inventor enables both contrast and tag persistence through the whole cardiac cycle interval.

The advantages of the inventor's approach of using multiple preparatory sequences within a single cardiac cycle (discussed in the Summary of the Invention section) include more efficient use of imaging time, lower SAR, and the ability to employ multiple imaging modalities within a single cardiac cycle interval, such as cardiac stress/strain/motion imaging and perfusion imaging.

Accordingly, Applicants respectfully submit that claims 1-3 and 5-14 are in condition for allowance. Accordingly, Applicants respectfully request allowance of claims 1-3 and 5-14.

Claim 4 Distinguishes Over The References Of Record

Claim 4 calls for first and second data preparation sequence blocks within one cardiac cycle. Zhu and Prince both suggest only a single preparation sequence per cardiac cycle. Accordingly, it is submitted that claim 4 is not anticipated by Zhu or Prince.

Claims 15 16 Patentably Distinguish Over The Cited References

Claim 15 has been placed into independent form. These claims stand rejected as anticipated by Prince.

However, Prince does not mention either perfusion or late enhancement, much less acquiring perfusion or late enhancement data using a second preparation sequence block.

A claim is anticipated only if each and every element as set forth in the claim is found, either expressly or inherently described, in a single prior reference.

See MPEP § 2131. Because claim 15 includes elements not found either expressly or inherently in Prince, it is respectfully requested that the anticipation rejection of claim 15 be withdrawn.

There being no other pending rejection of claim 15, Applicants respectfully submit that claims 15 and 16 as set forth herein are not anticipated by and patentably distinguish over the references of record, and ask for allowance of claims 15 and 16 as set forth herein.

Claim 18 Patentably Distinguishes Over The Cited References

Claim 18 has been placed into independent form including the elements of cancelled claim 17.

Claim 18 as set forth herein calls for applying a first preparatory sequence block to the patient at a first point in the cardiac cycle interval, acquiring first image data responsive to the first preparatory sequence block, applying a second preparatory sequence block to the patient at a second point in the cardiac cycle interval different from the first point in the cardiac cycle, and acquiring second image data responsive to the second preparatory sequence block. The total time interval over which the applying of the first preparatory sequence block, the acquiring of first image data, the applying of the second preparatory sequence block, and the acquiring of second image data occur is less than a single cardiac cycle interval.

Claim 18 stands rejected as anticipated by Prince.

The basis for rejection of claim 18 stated in the Office Action at page 4 does not purport to find the element of claim 18 that that the total time interval over which the acquiring of first image data, the applying of the second preparatory sequence block, and the acquiring of second image data occur is less than a single cardiac cycle interval. Accordingly, Applicants respectfully request that the anticipation rejection be withdrawn. There being no other pending rejection of claim 18, Applicants respectfully submit that claim 18 as set forth herein patentably distinguish over the references of record, and ask for allowance of claim 18 as set forth herein.

Claims 19-24 Patentably Distinguish Over The Cited References

Claim 19 as set forth herein calls for, among other elements, an imaging sequence processor performing an MRI data acquisition sequence including: a first preparatory sequence block initiated at a first point in a cardiac cycle that produces a first modification of heart magnetization, a first imaging sequence block including at least one readout that produces first image data associated with the heart, a second preparatory sequence block spaced apart from the first preparatory sequence block and initiated at a second point different from the first point in the same cardiac cycle that produces a second modification of heart magnetization, and a second imaging sequence block including at least one readout that produces second image data associated with the heart. The data acquisition sequence occurs over an acquisition time interval which is smaller than a cardiac cycle interval.

Claim 19 calls for first and second spaced apart preparatory sequences, each initiating at different points in the same cardiac cycle. Zhu shows only a single contiguous preparatory sequence (202, 2020) in each cardiac cycle. (*See* Zhu Figs. 2 and 5). Prince discloses a single preparatory sequence per cycle.

Accordingly, Applicants respectfully submit that claims 19-24 are in condition for allowance. Accordingly, Applicants respectfully request allowance of claims 19-24.

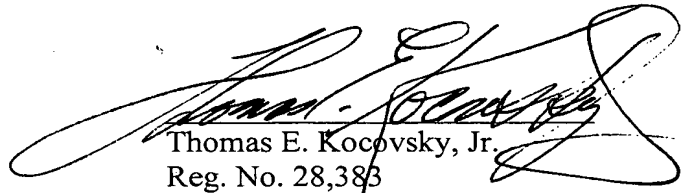
CONCLUSION

For the reasons set forth above, it is submitted that claims 1-16 and 18-24 as set forth herein distinguish patentably over the references of record and meet all statutory requirements. An early allowance of all claims is requested.

In the event the Examiner considers personal contact advantageous to the disposition of this case, he is requested to telephone Thomas Kocovsky at (216) 861-5582.

Respectfully submitted,

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A large, stylized handwritten signature in black ink, likely belonging to Thomas E. Kocovsky, Jr., is written over the printed name and address.

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